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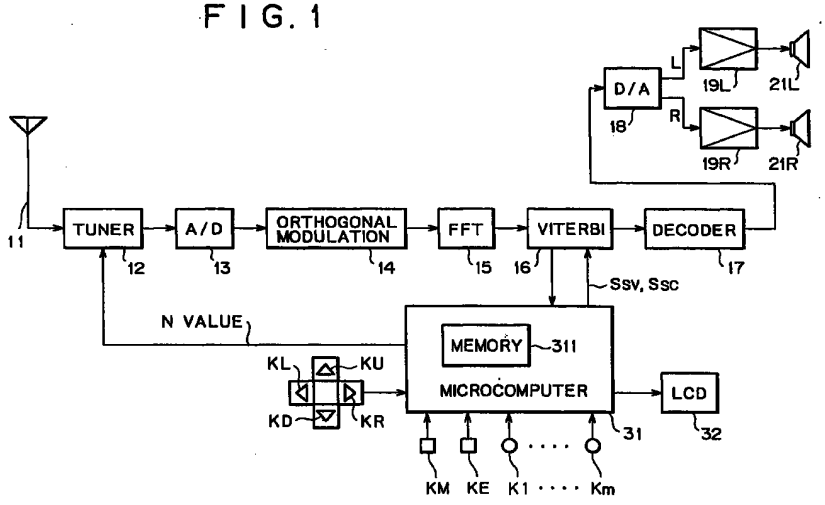
(54) Receiver for the reception of Digital Audio Broadcast (DAB)

(57) A receiver for digital audio broadcasting for selecting a program readily with improved operability is disclosed. The digital audio receiver receives a digital broadcast including a plurality of programs classified in levels of hierarchy and being broadcast with a single transmission band, and includes a display unit for displaying information on a program being received and displaying items of one of the hierarchy levels in the form of a list, and a control section to which first and second operation keys, a display mode key and a decision key are connected. Under the control of the control section, upon the operation of the display mode key to establish a first display mode, information on the program being received is displayed on the display unit; upon the operation of the display mode key to establish a second display mode, the items in the hierarchy level are displayed in the form of a list on the display unit; upon the operation of the first operation key, the level to be displayed is changed; upon the operation of the second operation key, an item of the level displayed is selected; and upon the operation of the decision key for a result of the selection, a program corresponding to the selected item is selected.

FIG. 1



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Description

[0001] This invention relates to a receiver for digital audio broadcasting.

[0002] In Europe, DAB (Digital Audio Broadcasting) according to the Eureka 147 standards is employed as digital audio broadcasting.

[0003] The DAB adopts:

transmission bandwidth: 1.5 MHz
modulation system: OFDM (Orthogonal Frequency Division Multiplex)
data compression system for an audio signal: MPEG audio layer II

in order to simultaneously broadcast a maximum of 64 digital audio signals and/or digital data signals.

[0004] To this end, in the DAB, a broadcast of programs has a hierarchical structure such as shown, for example, in FIG. 13. In particular, the DAB uses the transmission bandwidth of 1.5 MHz for one channel as mentioned above, and the transmission channel is called "ensemble" as seen in FIG. 13. Each ensemble is selected by tuning with the central frequency of the ensemble.

[0005] The ensemble is divided into groups called services. The ensemble A shown in FIG. 13 is divided into four services. Each service is divided into several "service components". Each service component is a digital audio signal or digital data which forms one program.

[0006] In this instance, a service corresponds to one of ordinary broadcasting stations and is used in such a manner that, for example, a soccer match (program 1A) played in a first location is broadcast in the first service component of the service 1 of the ensemble A and another soccer match (program 1B) played in a second location is broadcast in the second service component. Or, a service is used in such a manner that a news program is broadcast in English in the first service component and another news program is broadcast in French in the second service component.

[0007] Further, each of the ensembles and the services is given an identification code called "ensemble ID" or "service ID" for identifying the same. Each of the ensembles and the services is also given an "ensemble label" or "service label" for indicating the name of the same. It is to be noted that each service component is given a sub channel ID for identifying a sub channel which is a minimum information unit which can be selected by the receiver side. The service component is generally not given a label and is called like "primary service component", "secondary service component 1", "secondary service component 2" ... .

[0008] Since ensembles, services and service components in the DAB make up a hierarchical structure in this manner, in order to enjoy a program of the DAB, an ensemble (frequency) is selected first, and then one of a plurality of services included in the ensemble is selected, whereafter an object service component (program) is selected from within the selected service.

[0009] By the way, a presetting function is prepared in some FM receivers and AM receivers. If the presetting function is executed, then frequencies of broadcasts of broadcasting stations which can be received are registered into a memory for channel selection so that any of the registered broadcasting stations can thereafter be selected by simple key operations.

[0010] Thus, it is a possible idea to prepare such a presetting function as described above in a DAB receiver. However, while broadcasting stations and programs in FM broadcasting or AM broadcasting correspond in a one-by-one corresponding relationship to each other, in the DAB, ensembles, services and service components make up a hierarchical structure, and broadcasting stations and programs do not correspond in a one-by-one corresponding relationship to each other as described above.

[0011] Accordingly, even if frequencies or ensemble names of DAB stations are registered in a similar manner as in the case of an FM receiver or an AM receiver, an object program cannot be selected simply. Besides, since all DAB stations broadcast programs in such a hierarchical structure as shown in FIG. 13, selection of a program is further complicated.

[0012] It is an object of the present invention to provide a digital audio receiver for digital audio broadcasting by which a program can be selected readily.

[0013] In order to attain the object described above, according to the present invention, there is provided a digital audio receiver for receiving a digital broadcast which includes a plurality of programs classified in hierarchies and is broadcast with a single transmission band, comprising a display unit for displaying information regarding a program being received and displaying items of one of levels of the hierarchy in the form of a list, and control means to which first and second operation keys, a display mode key and a decision key are connected, the control means controlling so that, when the display mode key is operated to establish a first display mode, information regarding the program being received is displayed on the display unit; when the display mode key is operated to establish a second display mode, the items in the hierarchy are displayed in the form of a list on the display unit; when the first operation key is operated, the level of the hierarchy to be displayed on the display unit is changed; when the second operation key is operated, an item of the level of hierarchy displayed on the display unit is selected; and when the decision key is operated for a result of the selection, a program corresponding to the selected item is selected.

[0014] In the receiver for digital audio broadcasting, a level of the hierarchy is selected by the first operation key, and an item in the selected level of the hierarchy is selected by the second operation key. Then, a program

is selected in accordance with a result of the selection.

[0015] With the receiver for digital audio broadcasting, where a digital broadcast to be received includes a plurality of programs classified in levels of hierarchy, if the first operation key is pressed, then a level of the hierarchy to be selected can be freely moved to an upper level or a lower level. In the hierarchy level, whichever one of levels of the hierarchy after the level moved is, an object item can be selected using the second operation key. In this manner, the key operations are standardized. Accordingly, upon the selection of an object program, this can be selected simply.

[0016] The above and other objects, features and advantages of the present invention will become apparent from the following description and the appended claims, taken in conjunction with the accompanying drawings in which like parts or elements denoted by like reference symbols.

[0017] An embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

FIG. 1 is a block diagram showing a receiver for digital audio broadcasting to which the present invention is applied;

FIG. 2 is a transition diagram illustrating an example of operation of the receiver for digital audio broadcasting of FIG. 1;

FIG. 3 is a schematic view showing an example of a display by the digital audio broadcasting of FIG. 1;

FIG. 4 is a transition diagram illustrating an example of operation of the receiver for digital audio broadcasting of FIG. 1 in a preset list display mode or a reception list display mode;

FIGS. 5A, 5B and 5C are schematic views illustrating an example of operation of the receiver for digital audio broadcasting of FIG. 1 in an ensemble list display mode;

FIGS. 6A, 6B and 6C are schematic views illustrating an example of operation the receiver for digital audio broadcasting of FIG. 1 in the service list display mode;

FIGS. 7A and 7B are schematic views illustrating an example of operation of the receiver for digital audio broadcasting of FIG. 1 in the component list display mode;

FIG. 8 is a diagrammatic view illustrating an example of operation of the receiver for digital audio broadcasting of FIG. 1 in the preset list display mode;

FIG. 9 is a similar view but illustrating an example of operation of the receiver for digital audio broadcasting of FIG. 1 in the reception list display mode;

FIGS. 10, 11 and 12 are flowcharts illustrating an example of operation of the receiver for digital audio broadcasting of FIG. 1 when different keys are operated; and

FIG. 13 is a diagrammatic view showing a hierarchical structure of DAB broadcasting.

[0018] Referring to FIG. 1, there is shown a receiver for digital audio broadcasting to which the present invention is applied. Broadcasting signals of the DAB are received by an antenna 11, and the received signals are supplied to a tuner circuit 12. The tuner circuit 12 includes a PLL (Phase Locked Loop) not shown and is formed in a superheterodyne system such that a reception frequency may be changed by varying the dividing ratio N of a variable frequency dividing circuit not shown of the PLL. A baseband signal of the DAB is demodulated by and outputted from the tuner circuit 12 and is then supplied to an A/D converter 13, by which it is converted into a digital signal by A/D conversion.

[0019] The digital signal is supplied to an orthogonal modulation circuit 14, by which data of an in-phase component (real axis component) and an orthogonal component (imaginary axis component) are demodulated. An FFT circuit 15 complex Fourier transforms the data to reproduce multi-carriers, D-QPSK demodulates the data for the individual carriers and frequency deinterleaves the data. An output of the FFT circuit 15 is supplied to a Viterbi decoder circuit 16, by which deinterleaving and error correction are performed for the received data and digital audio data of an object service component (program) is selected.

[0020] Then, the selected data is supplied to an audio decoder circuit 17, by which decoding processing such as MPEG data decompression is performed for the data, and digital audio data of the object service component is outputted from the audio decoder circuit 17. The thus outputted digital audio data is supplied to a D/A converter circuit 18, by which it is converted into analog audio signals L and R by D/A conversion. The signals L and R are supplied to speakers 21L and 21R through amplifiers 19L and 19R, respectively.

[0021] A microcomputer 31 for controlling the system is provided as control means, and as frequency data to be used to select an ensemble (reception frequency), data of a frequency dividing ratio N of the variable frequency dividing circuit of the PLL is supplied from the microcomputer 31 to the tuner circuit 12.

[0022] Further, as data necessary to identify or specify a service and a service component, FIC (Fast Information Channel) data of a service ID, the number of service components included in the service, a sub channel ID and so forth are outputted from the Viterbi decoder circuit 16. The data are supplied to the microcomputer 31. Meanwhile, selection signals SSV and SCH are supplied from the microcomputer 31 to the Viterbi decoder circuit 16. By the Viterbi decoder circuit 16, a service is selected in accordance with the signal SSV, and digital audio data of an object service component is selected from within the selected service in accordance with the signal SSC.

[0023] Further, as part of a program to be executed by a CPU (not shown) of the microcomputer 31, for

example, such routines 100 to 300 as illustrated in FIGS. 10 to 12 are prepared in the microcomputer 31. It is to be noted that, in FIGS. 10 to 12, only those steps which relate to the present invention are shown in excerption whereas details of the routines 100 to 300 are hereinafter described.

[0024] The microcomputer 31 includes a memory 311 for storing and retaining data for program selection. The memory 311 is formed from, for example, a flash memory or, though not shown, a C-MOS memory which is backed up by a battery, that is, a nonvolatile memory so that, also when the power supply is disconnected, data written therein may be retained.

[0025] It is to be noted that the data for program selection stored in the memory 311 are data necessary to select, for each of programs, the program and include an ensemble ID, a service ID, a sub channel ID, an ensemble label, a service label, a dividing ratio N and so forth. Such program selection data are stored into the memory 311 when a key operation for presetting is performed or when a program is selected and decided by manual operation.

[0026] Further, for example, an LCD (Liquid Crystal Display) unit 32 is connected as a display unit to the microcomputer 31. The LCD unit 32 can display characters and so forth in a necessary size in the form of combinations of dots arranged in a matrix thereon.

[0027] Furthermore, various operation keys KU, KD, KL, KR, KM, KE and K1 to Km each in the form of, for example, a non-lock type push switch are connected to the microcomputer 31.

[0028] In this instance, the keys KU, KD, KL and KR are selection keys for selecting an ensemble, a service and a service component and are arranged, for example, in a cross-shaped arrangement on an operation panel not shown of the receiver taking facility in operation into consideration. In particular, the upward key KU and the downward key KD are disposed in a juxtaposed relationship in an upward and downward direction, and the leftward key KL and the rightward key KR are disposed in a juxtaposed relationship in a leftward and rightward direction. It is to be noted that operation portions themselves of the keys KU, KD, KL and KR can be formed integrally in a cross-shaped arrangement.

[0029] The key KM is a display mode key for selecting a display mode when a broadcasting station name, a service name and a program name are displayed. The key KE is a decision key for rendering an item selected using the selection keys KU to KR valid. Further, the keys K1 to Km are keys for performing general operations of the receiver.

[0030] If the display mode key KM of the receiver for digital audio broadcasting having the construction described above is pressed, then each time it is pressed, the display mode of the LCD unit 32 is successively and repetitively switched like, as shown in FIG. 2, "Normal display mode" → "Reception list display mode" → "Preset list display mode" → "Normal display mode" → ... . The displays described below are given in the display modes just mentioned.

"Normal Display Mode"

[0031] In the normal display mode, for example, such a display as seen in FIG. 3 is provided on the LCD unit 32 based on data obtained from a broadcast being received. In particular, an ensemble name, a service name, a program name and so forth of a program being currently received are displayed on the LCD unit 32.

[0032] In this instance, while the ensemble name and the service name can be displayed using an ensemble label and a service label transmitted together with the program, since generally a label which directly indicates a service component is not transmitted, it is displayed, for example, like "Primary" from a relationship to the "service" and the "service component".

"Preset List Display Mode"

[0033] The preset list display mode is a mode for selecting and deciding an ensemble, a service and a service component in accordance with the program selection data stored in the memory 311. The preset list display mode is further divided into, for example, as shown in FIG. 4, an "Ensemble list display mode", a "Service list display mode" and a "Component list display mode".

[0034] The ensemble list display mode is a mode for selecting and deciding an ensemble. The service list display mode is a mode for selecting and deciding a service in an ensemble selected and decided in the ensemble list display mode. Further, the component list display mode is a mode for selecting and deciding a service component in a service selected and decided in the service list display mode.

[0035] Then, as seen also in FIG. 4, if the rightward key KR is pressed, then each time it is pressed, the display mode of the LCD unit 32 is successively and repetitively switched like the ensemble list display mode → service list display mode → component list display mode → ensemble list display mode → ... .

[0036] On the other hand, if the leftward key KL is pressed, then each time it is pressed, the display mode of the LCD unit 32 is successively and repetitively switched like, reversely to that when the rightward key KR is pressed, the ensemble list display mode → component list display mode → service list display mode → ensemble list display mode → ... .

[0037] In any of the display modes mentioned, display, selection and decision of an ensemble, a service or a service component can be performed in the following manner in accordance with the program selection data stored in the memory 311. It is to be noted that the following description proceeds on the assumption that labels and IDs of ensembles, services and service components having such a structure as shown in FIG. 8 are

stored as part of the program selection data in the memory 311.

[0038] Further, in the following description, as seen in FIG. 8, a list of ensemble names is referred to as "ensemble list"; a list of service names of any ensemble is referred to as "service list"; and a list of character trains indicating service components of any service is referred to as "component list".

"Ensemble List Display Mode"

[0039] In the ensemble list display mode, an ensemble list is displayed on the LCD unit 32 from an ensemble label stored in the memory 311 so that an object ensemble can be selected from within the ensemble list.

[0040] In particular, where ensemble labels of the ensembles shown in FIG. 8 are stored, character trains of "Ensemble A", "Ensemble B", "Ensemble C", ... are displayed in the form of a list at a ratio of one row per one ensemble as ensemble names as shown in FIG. 5A on the LCD 32.

[0041] In this instance, if the ensemble being received is, for example, the ensemble B, then the mark * is displayed in front of the character train which indicate the ensemble B being received and the character train is surrounded by a rectangular frame which represents a cursor as shown in FIG. 5A.

[0042] Then, if the downward key KD is pressed when the displaying condition is such as just described, then the cursor moves to the position of the ensemble name in the next lower row as shown in FIG. 5B. Then, if the downward key KD is pressed again, then the cursor moves to the position of the ensemble name in the next lower row as shown in FIG. 5C. In this manner, each time the downward key KD is pressed, the cursor successively moves by a one-ensemble distance in the downward direction.

[0043] It is to be noted that, if the number of ensembles is so large that the ensemble list cannot be displayed fully on one screen of the LCD unit 32, the ensemble names are scrolled on the display. Further, if the downward key KD is pressed when the cursor is displayed at the position of the ensemble name of the last row, then the key operation is ignored.

[0044] On the other hand, if the upward key KU is pressed, for example, in the displaying condition of FIG. 5C, then the cursor moves to the position of the ensemble name in the next upper row as shown in FIG. 5B. Then, if the upward key KU is pressed again, then the cursor moves to the position of the ensemble name in the further upper row as shown in FIG. 5A. In this manner, each time the upward key KU is pressed, the cursor successively moves by a one-ensemble distance in the upward direction. It is to be noted that, if the upward key KU is pressed when the cursor is displayed at the position of the ensemble name in the top row, then the key operation is ignored.

[0045] In this manner, by pressing the downward key KD or the upward key KU, the cursor can be moved to the position of an arbitrary ensemble name in the ensemble list. Further, the mark * is displayed additionally to the ensemble name of the ensemble being currently received.

[0046] Then, if the rightward key KR is pressed when the cursor is positioned at the position of the ensemble name of an object ensemble name, then since the current display mode is the ensemble list display mode, the display mode is changed to the service list display mode as described hereinabove with reference to FIG. 4. Further, in this instance, the dividing ratio N for receiving the ensemble at the position of the cursor is read out from the memory 311 and stored once into a RAM (not shown) of the microcomputer 31.

[0047] Accordingly, in the ensemble list display mode, an arbitrary one of the ensembles stored in the memory 311 can be selected using the upward and downward keys KU and KD and stored once.

"Service List Display Mode"

[0048] In the service list display mode, those ones of service labels stored in the memory 311 which are of services of an ensemble selected in the ensemble list display mode are read out, and a service list is displayed on the LCD unit 32 based on the service labels thus read out so that an object service can be selected from within the service list.

[0049] In particular, for example, if service labels of services surrounded by a broken line frame in FIG. 8 are stored in the memory 311 and the ensemble B is selected in the ensemble list display mode, then the character trains of "Service 1", "Service 2, ..., "Service 5" of the ensemble B are displayed as service names in the form of a list at a ratio of one row per one service on the LCD unit 32 as shown in FIG. 6A.

[0050] Further, in this instance, if the service being currently received is, for example, the service 2, then the mark * is displayed in front of the character train indicating the service 2 being received and the character train is displayed as surrounded by a rectangular frame indicating the cursor as shown in FIG. 6A.

[0051] Then, where the displaying condition is such as just described, if the downward key KD is pressed, then the cursor moves to the position of the service name in the next lower row as shown in FIG. 6B. Then, if the downward key KD is pressed again, then the cursor moves to the position of the service name in the further lower low as shown in FIG. 6C. In this manner, each time the downward key KD is pressed, the cursor is successively moved downwardly by a one-service distance.

[0052] It is to be noted that, where the number of services is so large that the service list cannot fully be displayed on one screen of the LCD unit 32, then the service names are scrolled on the display. Further, if the downward key KD is pressed when the cursor is dis-

played at the position of the service name in the last row, then the key operation is ignored.

[0053] On the other hand, for example, if the upward key KU is pressed in the displaying condition of FIG. 6C, then the cursor moves to the position of the service name in the next upper row as shown in FIG. 6B. Further, if the upward key KU is pressed again, then the cursor moves to the position of the service name in the further upper row as shown in FIG. 6A. In this manner, each time the upward key KU is pressed, the cursor successively moves upwardly by a one-service distance. It is to be noted that, if the upward key KU is pressed when the cursor is displayed at the position of the service name in the top row, then the key operation is ignored.

[0054] In this manner, by pressing the downward key KD or the upward key KU, the cursor can be moved to the position of an arbitrary service name of the service list. Further, the mark * is displayed in front of the service name of the service being currently received.

[0055] Then, if the rightward key KR is pressed when the cursor is positioned at the position of the service name of the object service, then since the current display mode is the service list display mode, the display mode changes to the component list display mode as described hereinabove with reference to FIG. 4. Further, in this instance, the service ID of the service at the cursor position is stored once into the RAM of the microcomputer 31.

[0056] Accordingly, in the service list display mode, an arbitrary one of those of the services stored in the memory 311 Which are of an ensemble selected in the ensemble list display mode can be selected using the upward key KU or downward key KD and stored once.

"Component List Display Mode"

[0057] In the component list display mode, those of the service components stored in the memory 311 which are of a service selected in the service list display mode are read out, and an object service component can be selected.

[0058] In particular, for example, where service components shown surrounded by a broken line frame in FIG. 8 are stored in the memory 311 and the service 2 of the ensemble B is selected in the service list display mode, the character trains of "Primary service component" and "Secondary service component" are displayed as service component names in the form of a list at a ratio of one row per one service component as shown in FIG. 7A on the LCD unit 32.

[0059] Further, if the service component being received then is, for example, the primary service component, then the mark * is displayed in front of the character train indicating the primary service component being received, and the character train is displayed in a reverse display which represents the cursor.

[0060] If the downward key KD is pressed in such a displaying condition as just described, then the cursor moves to the position of the service component name in the next lower row as shown in FIG. 7B. In this manner, each time the downward key KD is pressed, the cursor successively moves downwardly by a one-service component distance.

[0061] It is to be noted that, if the number of service components is so large that the component list cannot be displayed fully on one screen of the LCD unit 32, then the service component names are scrolled on the display. Further, if the downward key KD is pressed when the cursor is displayed at the position of the service component name in the last row, the key operation is ignored.

[0062] On the other hand, for example, if the upward key KU is pressed in the displaying condition FIG. 7B, then the cursor moves to the position of the service component name in the next upper row as shown in FIG. 7A. In this manner, each time the upward key KU is pressed, the cursor successively moves upwardly by a one-service component distance. It is to be noted that, if the upward key KU is pressed when the cursor is positioned at the position of the service component name in the top row, then the key operation is ignored.

[0063] In this manner, by pressing the downward key KD or the upward key KU, the cursor can be moved to the position of an arbitrary one of the service component names displayed in the form of a list. Further, the mark * is displayed in front of the service component name of the service component being currently received.

[0064] Then, if the decision key KE is pressed when the cursor is positioned at the position of the service component name of the object service component, then the data for selecting the service component at the cursor position is stored once into the RAM of the microcomputer 31.

[0065] Accordingly, in the component list display mode, an arbitrary one of those of the service components stored in the memory 311 which are of a service selected in the service list display mode can be selected using the upward key KU or downward key KD and stored once.

[0066] Then, since the decision key KE is pressed now in the component list display mode, the dividing ratio N which was stored once into the RAM of the microcomputer 31 in the ensemble list display mode is read out. The dividing ratio N read out in this manner is set to the tuner circuit 12 so that the selected ensemble is received in the ensemble list display mode.

[0067] Then, the service ID which was stored once into the RAM of the microcomputer 31 in the service list display mode is read out. A selection signal SSV corresponding to the thus read out service ID is supplied to the Viterbi decoder circuit 16, by which the service of the service ID is selected. Further, the sub channel ID which was stored once into the RAM of the microcom-

puter 31 in the component list display mode is read out. A selection signal SSC corresponding to the thus read out service component is supplied to the Viterbi decoder circuit 16, by which the service component is selected.

[0068] Accordingly, the program is selected successfully in accordance with the program selection data stored in the memory 311, and thereafter, the program can be enjoyed. Further, the display mode returns to the normal display mode.

[0069] In this manner, in the preset list display mode, selection of a program can be performed within the range of the program selection data stored in the memory 311. Then, in this instance, the hierarchy level of an ensemble, a service or a service component can be selected using the left key KL or right key KR, and in the selected level, an object item can be selected using the upward key KU or downward key KD whatever the selected level is.

"Reception List Display Mode"

[0070] In the reception list display mode, similar processing to that in the preset list display mode described above is performed making use of data included in a signal being received.

[0071] In particular, in the DAB, for example, when the ensemble A is being received as shown in FIG. 9, the ensemble A is sometimes broadcasting various information of the other ensembles B and C. Thus, in the reception list display mode, if not only information of the ensemble being received but also information regarding the other ensembles are available, then such information is used to display the names of the other ensembles to allow selection of them.

[0072] To this end, also the reception list display mode is divided into, for example, as shown in FIG. 4, an "Ensemble list display mode", a "Service list display mode" and a "Component list display mode" as shown in FIG. 4.

[0073] Then, if program selection data obtained from the ensemble being currently received is used in place of the program selection data of the memory 311 used in the preset list display mode, then the "ensemble list display mode", "service list display mode" and "component list display mode" are realized in a similar manner as in the preset list display mode.

[0074] Accordingly, also in the reception list display mode, a program can be selected from within the range of program selection data obtained from the ensemble being currently received. Then, also in the reception list display mode, the hierarchy level of an ensemble, a service or a service component can be selected using the leftward key KL or rightward key KR, and in the selected level, an object item can be selected using the upward key KU or downward key KD whatever the selected level is.

"Routines 100 to 300"

[0075] Here, the routines 100 to 300 are described.

[0076] The routine 100 illustrated in FIG. 10 is for realizing switching of the display mode illustrated in FIG. 2 and is executed when the mode key KM is pressed. Then, in the routine 100, it is discriminated which one of the normal display mode, preset list display mode and reception list display mode the current display mode is, and the display mode is switched to a next mode in accordance with a result of the discrimination.

[0077] Meanwhile, the routine 200 illustrated in FIG. 11 is for realizing, in the preset list display mode and the reception list display mode, switching of the display mode illustrated in FIG. 4, and is executed when the leftward key KL or the rightward key KR is pressed. Then, in the routine 200, it is discriminated which one of the ensemble list display mode, service list display mode and component list display mode the current display mode is. Then, the display mode is switched to another display mode in an upper or lower level of the hierarchy in accordance with a result of the discrimination.

[0078] Further, the routine 300 illustrated in FIG. 12 is for realizing a movement of the cursor in FIGS. 5 to 7 in the ensemble list display mode, service list display mode and component list display mode, and is executed when the upward key KU or the downward key KD is pressed. Then, in the routine 300, if the pressed key is the upward key KU, then the cursor is moved upwardly by a one-row distance, but if the pressed key is the downward key KD, then the cursor is moved downwardly by a one-row distance.

[0079] While the DAB receiver of FIG. 1 can select a program (service component) in such a manner as described above, in this instance, whichever one of the preset list display mode and the reception list display mode the display mode particularly of the DAB receiver described above is, when the leftward key KL or rightward key KR is pressed, the hierarchy level of an ensemble, a service or a service component can be moved freely upwardly or downwardly. Then, in the hierarchy level after the level is moved, whatever the hierarchy level is, an object item can be selected using the upward key KU or downward key KD. In short, the key operation is standardized irrespective of the display mode or irrespective of the level of the hierarchy. Accordingly, when an object program is to be selected, this can be selected simply.

[0080] It is to be noted that, if the downward key KD is pressed when the cursor is in the last row in the ensemble list display mode, service list display mode or component list display mode as described above, the cursor may otherwise be moved to the top row so that, each time the downward key KD is pressed thereafter, the cursor may be moved downwardly by a one-row distance, but if the upward key KU is pressed when the cursor is in the top row, the cursor may otherwise be moved to the last row so that, each time the upward key KU is

pressed thereafter, the cursor may be moved upwardly by a one-row distance.

[0081] It is to be noted that, whereas it is described hereinabove that the cursor is displayed at an item of an object of selection in the ensemble list display mode, service list display mode or component list display mode, a pointer such as an arrow mark may be used instead. Or, the display color of an object item may be made different. In other words, the display form of an object item should be made different. Also an item being currently received may be displayed in a similar manner.

[0082] While a preferred embodiment of the present invention has been described using specific terms, such description is for illustrative purposes only, and it is to be understood that changes and variations may be made without departing from the scope of the following claims.

Claims

1. A digital audio receiver for receiving a digital broadcast which includes a plurality of programs classified in levels of hierarchy and which is broadcast within a single transmission band, comprising:

   a display unit for displaying information regarding a program being received and displaying items of one of the levels of the hierarchy in the form of a list; and
   control means to which first and second operation keys, a display mode key and a decision key are connected;
   said control means being arranged for controlling the receiver so that, when said display mode key is operated to establish a first display mode, information regarding the program being received is displayed on said display unit; when said display mode key is operated to establish a second display mode, the items in the level of the hierarchy are displayed in the form of a list on said display unit; when said first operation key is operated, the level of the hierarchy to be displayed on said display unit is changed; when said second operation key is operated, an item of the level of the hierarchy displayed on said display unit is selected; and when said decision key is operated for a result of the selection, a program corresponding to the selected item is selected.

2. A receiver for digital audio broadcasting according to claim 1, wherein the highest level of the hierarchy is an ensemble, and the lowest level of the hierarchy is a service component.

3. A receiver for digital audio broadcasting according to claim 1 or 2, wherein said first operation key comprises a pair of keys arranged in a juxtaposed relationship in a leftward and rightward direction for moving the level of the hierarchy upward or downward.

4. A receiver for digital audio broadcasting according to claim 1, 2 or 3, wherein said second operation key comprises a pair of keys arranged in a juxtaposed relationship in an upward and downward direction for selecting one of the items, the items being displayed row by row in the form of a list on said display unit.

5. A receiver for digital audio broadcasting according to claim 1, 2, 3 or 4, wherein said control means includes a memory for storing data to be used for selection of one of the levels of the hierarchy and the programs, and said display unit displays the levels of the hierarchy and the items in accordance with the data stored in said memory.

FIG. 1

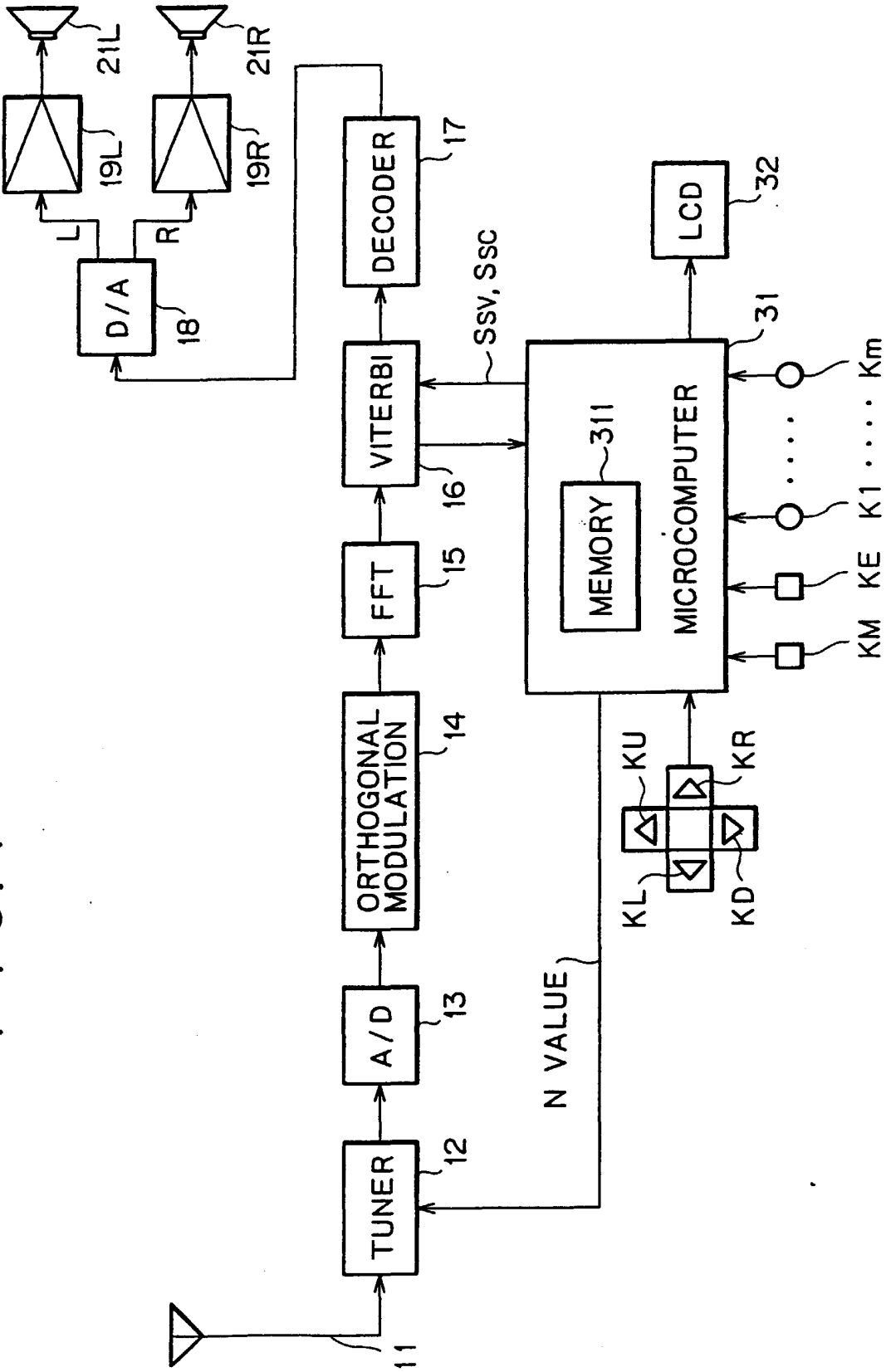

21L
21R
19L
19R
L
R
D/A
18
DECODER
17
VITERBI
16
Ssv, Ssc
FFT
15
ORTHOGONAL MODULATION
14
A/D
13
TUNER
12
11
N VALUE
LCD
32
31
MEMORY
311
MICROCOMPUTER
KU
KL
KR
KD
KM
KE
K1
Km

FIG. 2

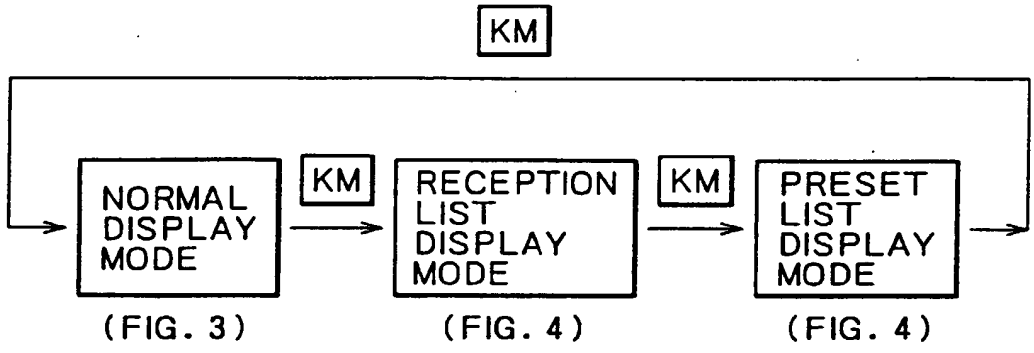


FIG. 3

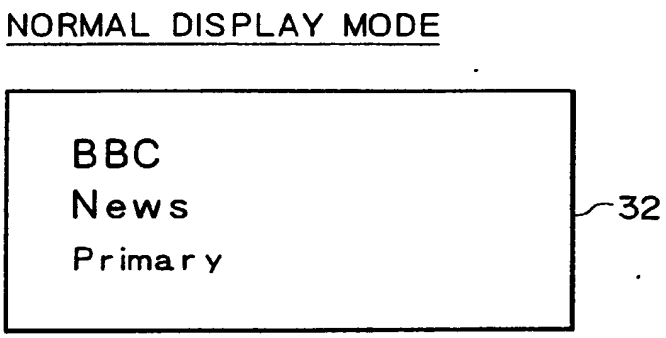


FIG. 4

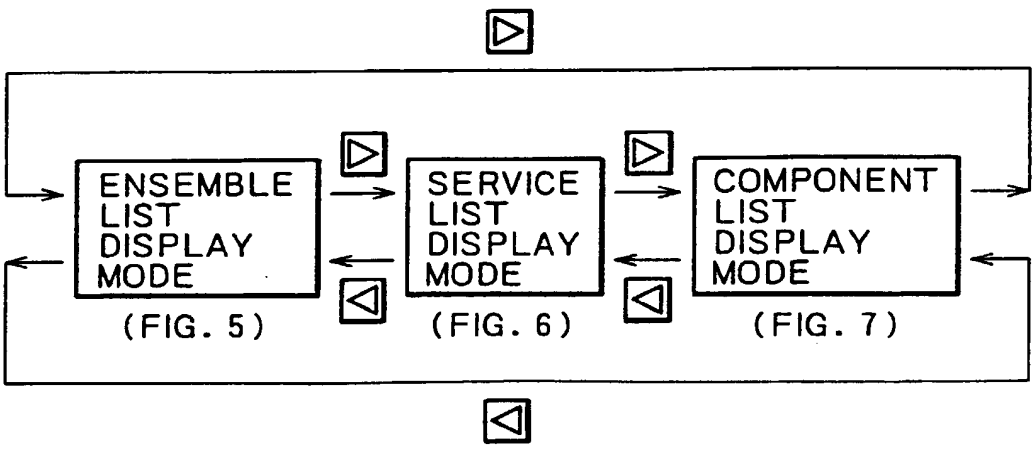


FIG.5A

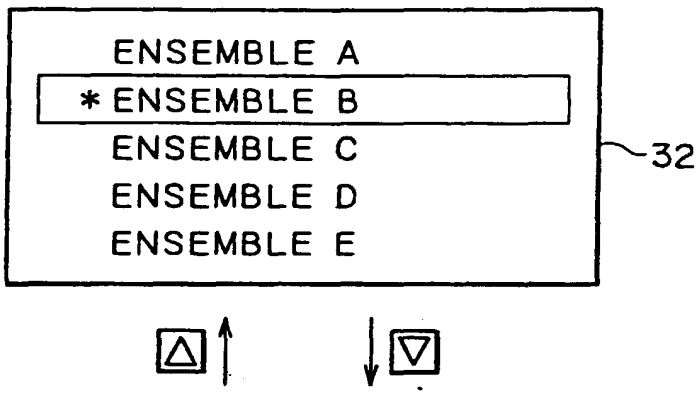


FIG.5B

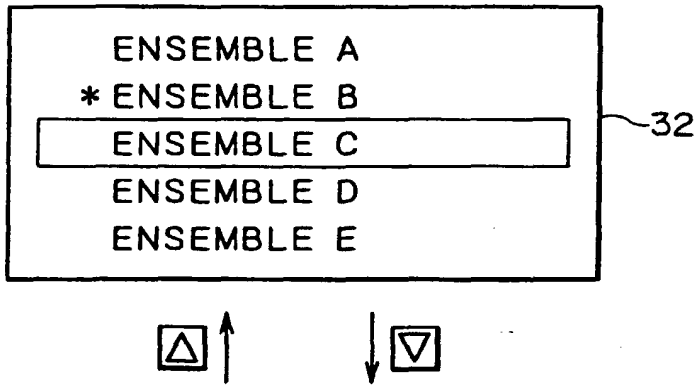
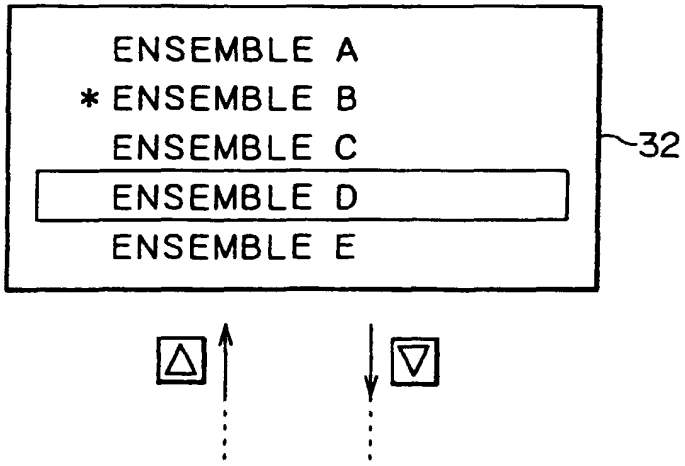


FIG.5C



SERVICE LIST DISPLAY MODE

FIG.6A

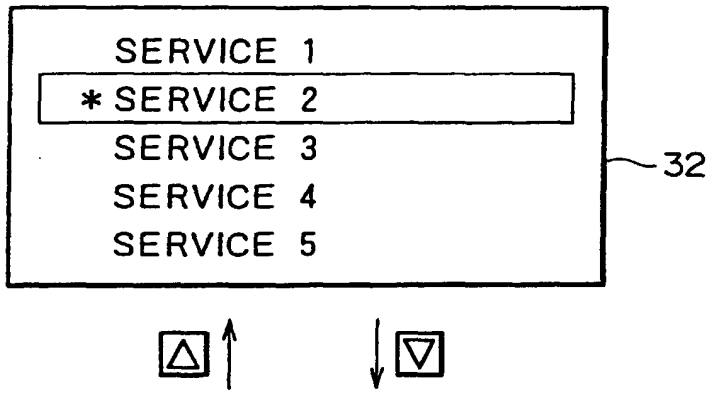


FIG.6B

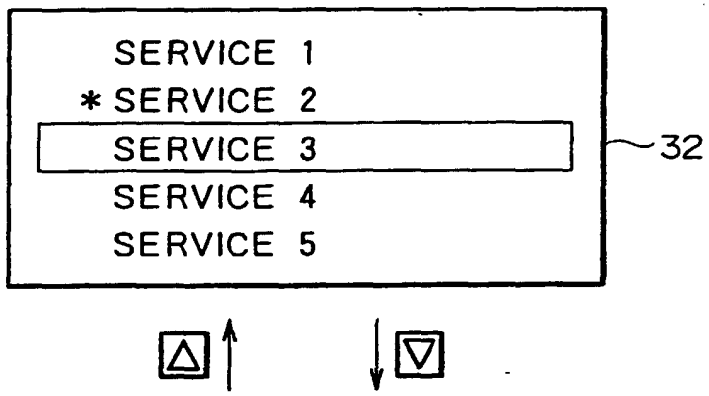


FIG.6C

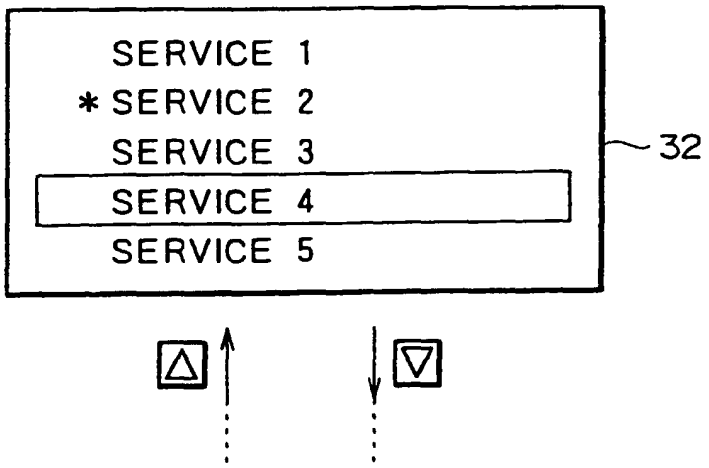


FIG. 7A

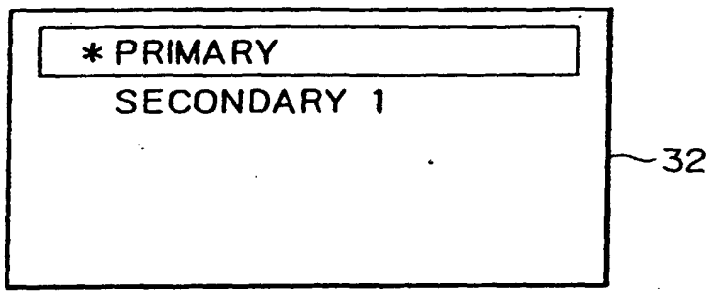

COMPONENT LIST DISPLAY MODE
* PRIMARY
SECONDARY 1
32

FIG. 7B

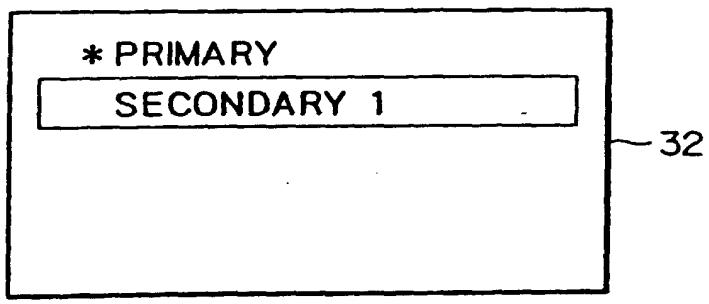

* PRIMARY
SECONDARY 1
32

FIG. 8

PRESET LIST DISPLAY MODE

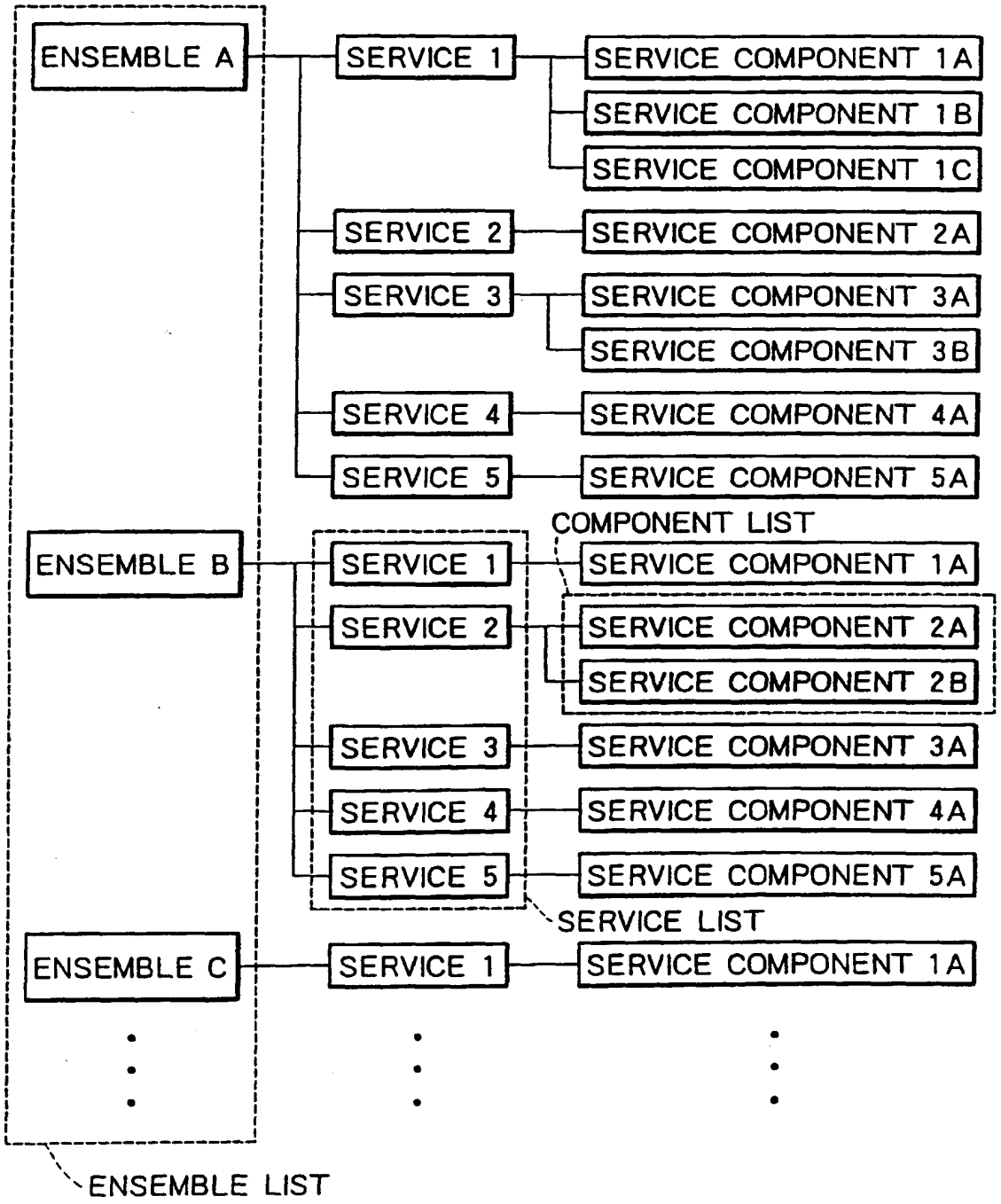


FIG. 9

RECEPTION LIST DISPLAY MODE

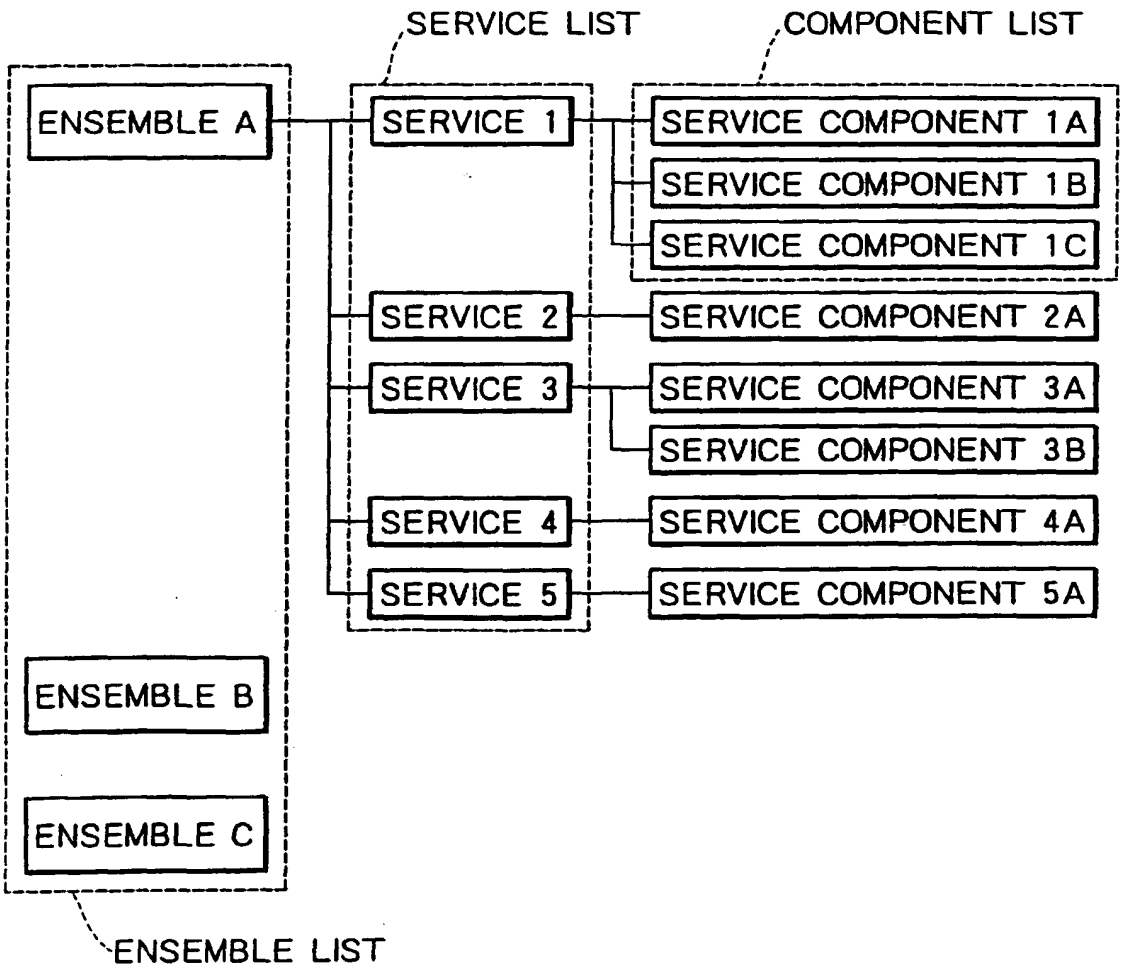


FIG. 10

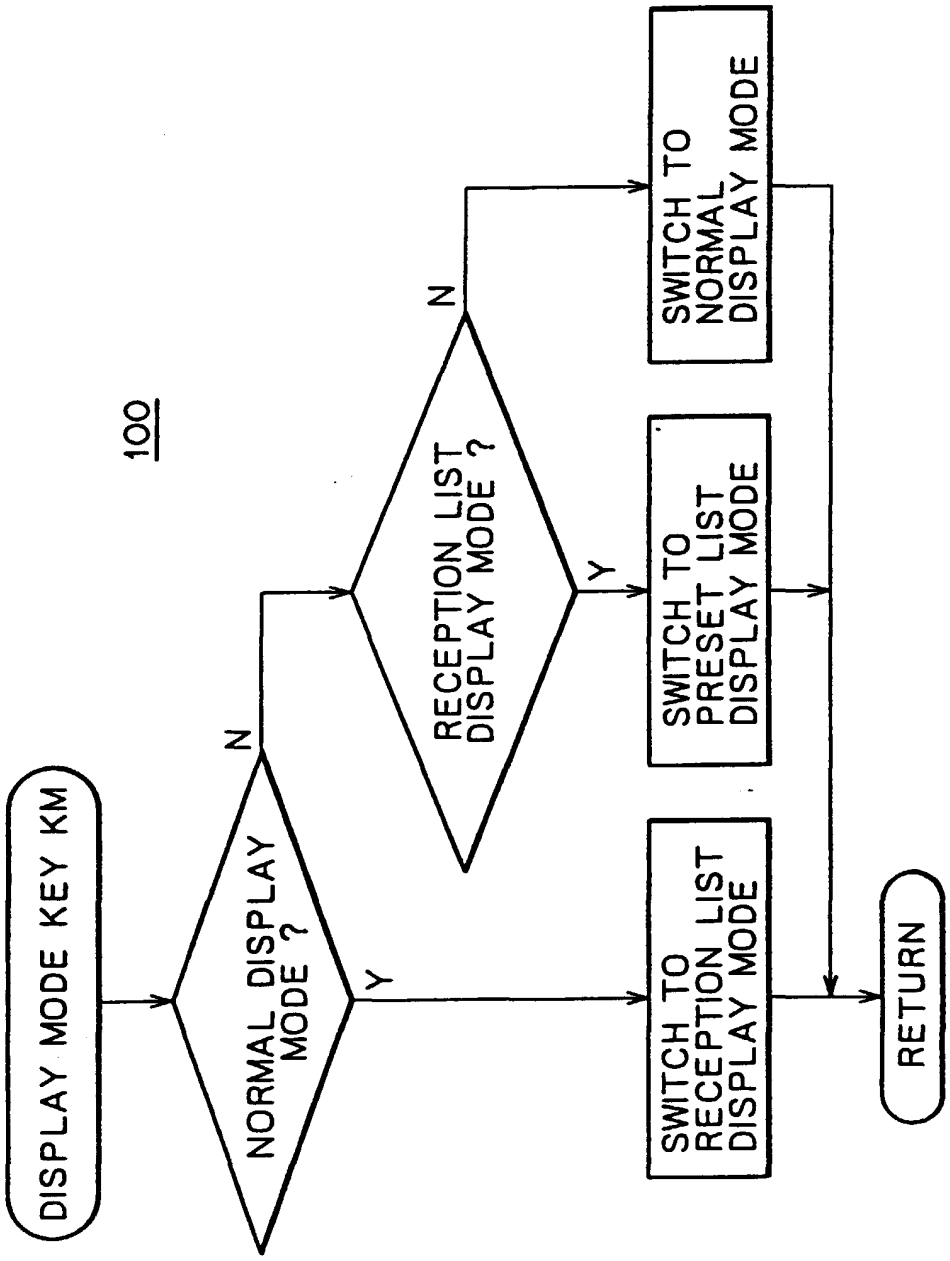

100
DISPLAY MODE KEY KM
NORMAL DISPLAY MODE ?
N
Y
RECEPTION LIST DISPLAY MODE ?
N
Y
SWITCH TO NORMAL DISPLAY MODE
SWITCH TO PRESET LIST DISPLAY MODE
SWITCH TO RECEPTION LIST DISPLAY MODE
RETURN

FIG. 11

200

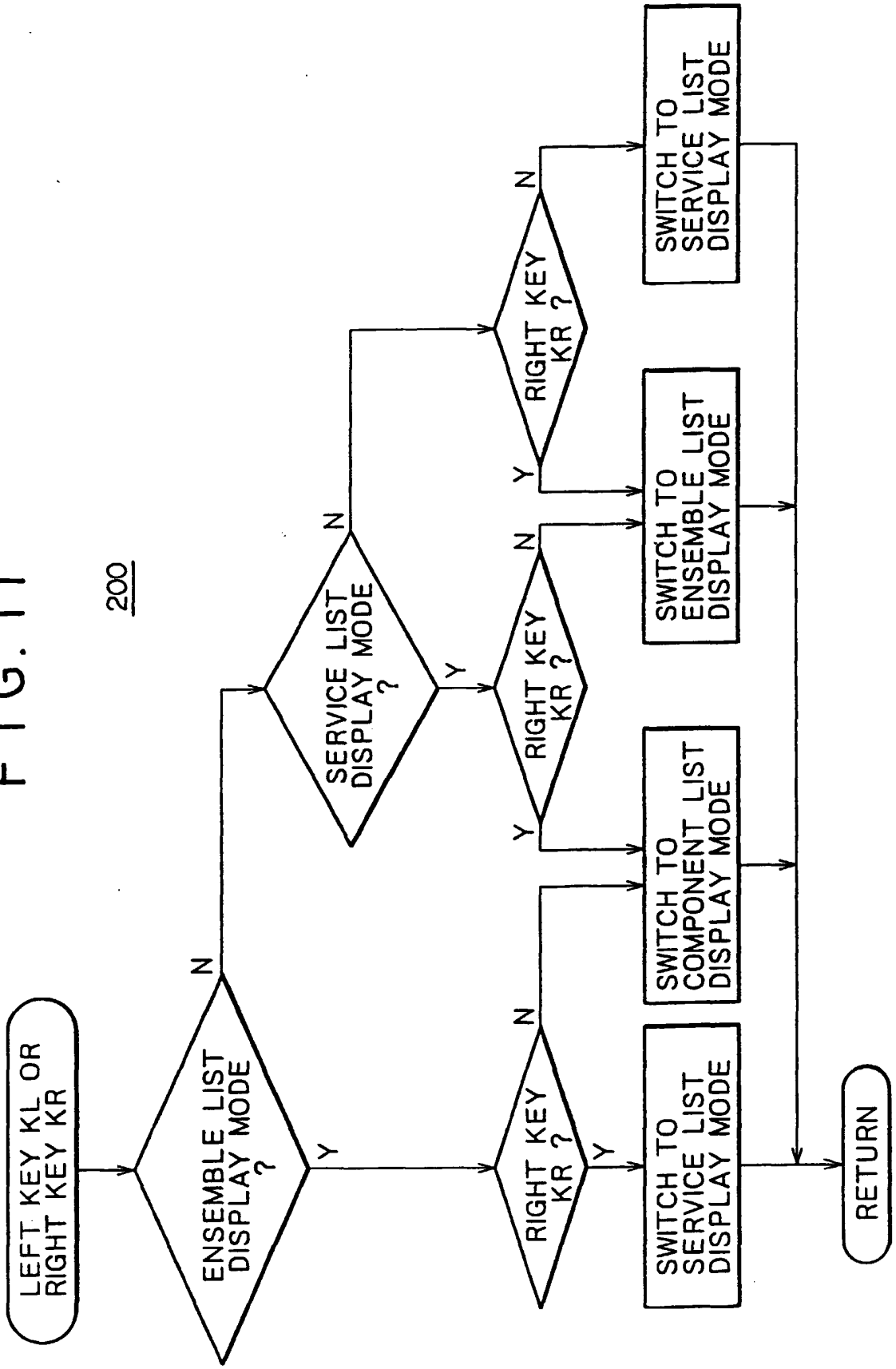

LEFT KEY KL OR RIGHT KEY KR
ENSEMBLE LIST DISPLAY MODE ?
N
Y
SERVICE LIST DISPLAY MODE ?
N
Y
RIGHT KEY KR ?
N
Y
RIGHT KEY KR ?
N
Y
RIGHT KEY KR ?
N
Y
SWITCH TO SERVICE LIST DISPLAY MODE
SWITCH TO ENSEMBLE LIST DISPLAY MODE
SWITCH TO COMPONENT LIST DISPLAY MODE
SWITCH TO SERVICE LIST DISPLAY MODE
RETURN

FIG. 12

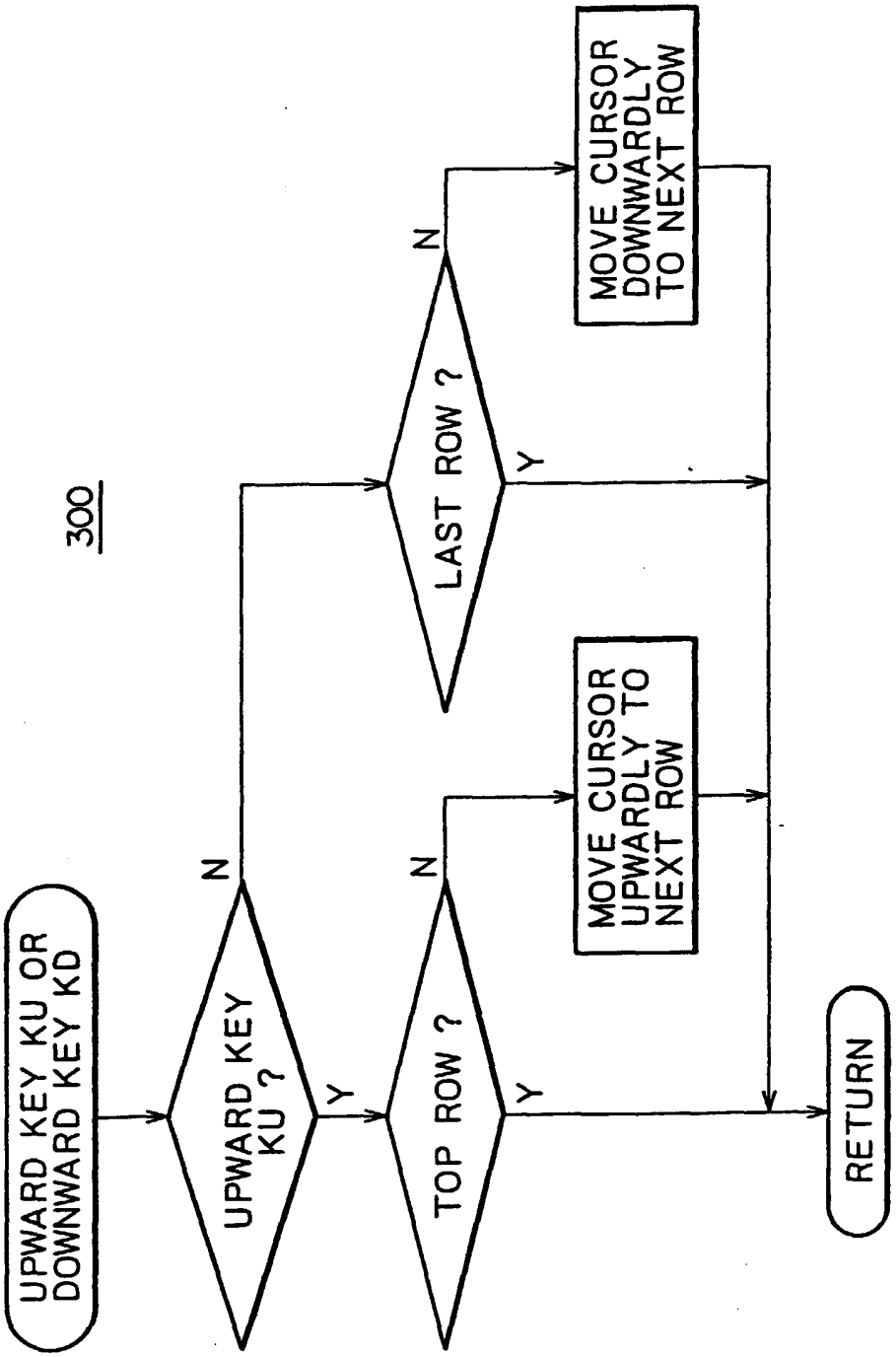
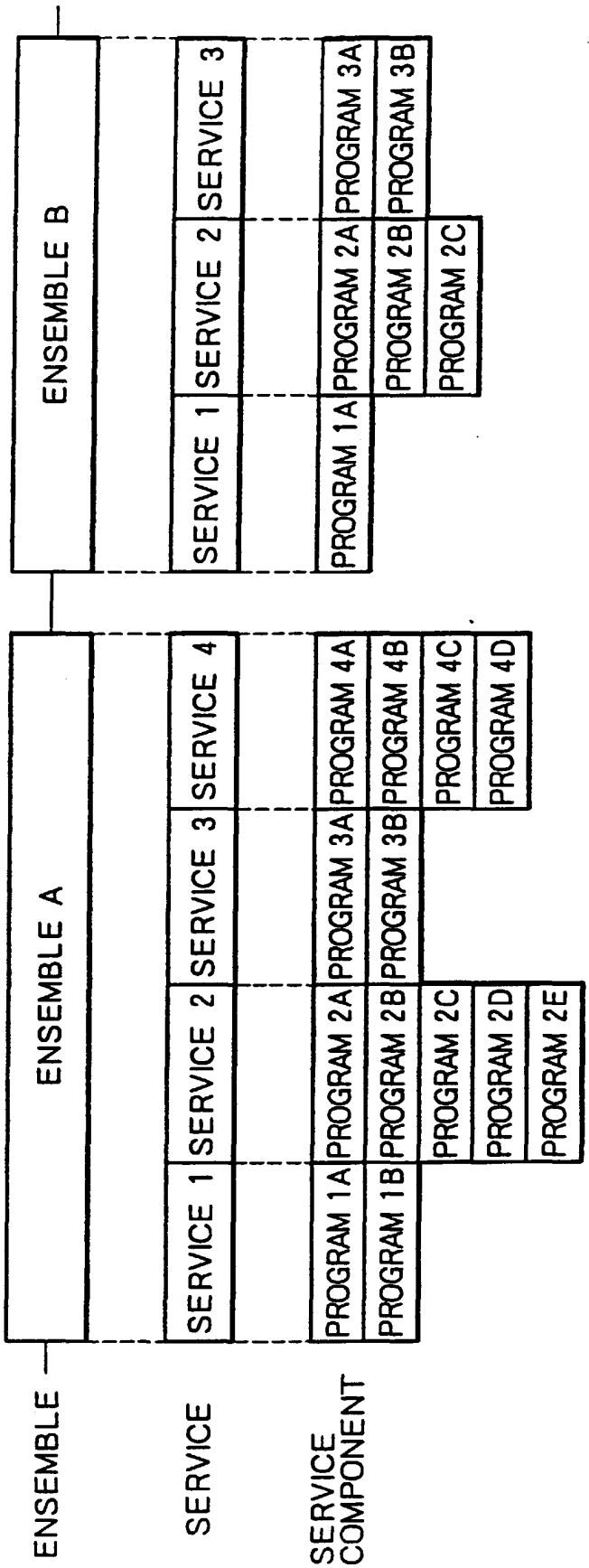

300
UPWARD KEY KU OR DOWNWARD KEY KD
UPWARD KEY KU ?
N
Y
TOP ROW ?
N
Y
MOVE CURSOR UPWARDLY TO NEXT ROW
LAST ROW ?
N
Y
MOVE CURSOR DOWNWARDLY TO NEXT ROW
RETURN

FIG. 13


ENSEMBLE
SERVICE
SERVICE COMPONENT
ENSEMBLE A
SERVICE 1
SERVICE 2
SERVICE 3
SERVICE 4
PROGRAM 1A
PROGRAM 1B
PROGRAM 2A
PROGRAM 2B
PROGRAM 2C
PROGRAM 2D
PROGRAM 2E
PROGRAM 3A
PROGRAM 3B
PROGRAM 4A
PROGRAM 4B
PROGRAM 4C
PROGRAM 4D
ENSEMBLE B
SERVICE 1
SERVICE 2
SERVICE 3
PROGRAM 1A
PROGRAM 2A
PROGRAM 2B
PROGRAM 2C
PROGRAM 3A
PROGRAM 3B